

What is claimed is:

1.

APL 6
An apparatus for measuring constituents of a substance comprising:

- 5 a light source capable of producing near infrared radiation in a controllable direction to a substance location;
a sensor oriented towards the substance location and capable of sensing infrared radiation reflected from or passing through the substance location;
10 a housing including a monochromator having no moving optical components and capable of isolating narrow portions of the infrared spectrum and a detector positioned to detect and quantify one or more isolated narrow portions of the infrared spectrum created by the monochromator;
15 a communication member between the sensor and the monochromator to transfer the sensed infrared radiation to the monochromator; and
a processor operatively connected to the monochromator capable of identifying and determining the amount of
20 constituents in the product based on the detected and quantified one or more isolated narrow portions of the infrared spectrum;
at least one of the housing and the substance location being movable relative to the other.

25

2.

The apparatus of claim 1 wherein the housing is mounted on a moveable carrier.

3.

30 The apparatus of claim 2 wherein the moveable carrier is selected from the set comprising an automobile, a trailer, a water craft, a barge, an agricultural implement, a rail car, and an aircraft.

4.

The apparatus of claim 1 wherein the substance is a pre-
35 harvested agricultural product.

5.

The apparatus of claim 4 wherein the pre-harvested agricultural product is selected from the set comprising fruit, vegetables, forage grains, whole grains, and
5 nutraceuticals.

6.

The apparatus of claim 1 wherein the substance is a post-harvested agricultural product.

7.

10 The apparatus of claim 6 wherein the post-harvested agricultural product is selected from the set comprising fruit, vegetables, forage grain, whole grain, and nutraceuticals.

8.

15 The apparatus of claim 1 wherein the substance is soil.

9.

The apparatus of claim 1 wherein the housing is stationary and the substance location is moveable relative to the housing.

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10.

The apparatus of claim 9 wherein the substance location is in or on a movable substance container.

11.

25 The apparatus of claim 10 wherein the moveable substance container is selected from the set comprising an automobile, a trailer, a water craft, a barge, an agricultural implement, an aircraft, a bin, and a conduit.

12.

30 The apparatus of claim 9 wherein the substance is moving is a transport vessel.

13.

35 The apparatus of claim 12 wherein the transport vessel is selected from the set comprising a pipeline, a trough, a conveyor, an auger, an automobile, a trailer, a rail car, a watercraft, an aircraft, and a conduit.

14.

The apparatus of claim 1 wherein the housing is mounted on a moveable carrier and the substance location is moveable.

15.

5 The apparatus of claim 1 further comprising a conduit forming a flow path for a substance wherein the substance location moves along the flow path.

16.

10 The apparatus of claim 15 further comprising a secondary conduit forming a diverted flow path for a substance and the substance location moves along the secondary conduit.

17.

15 The apparatus of claim 1 wherein the monochromator is a device without optical components sensitive to vibration and which isolate narrow portions of the NIR spectrum as selected from the set of methods comprising stationary interferometry, stationary Hadamard mask processes, acoustic-optic tunable filter processes (AOTF), and electro-optic modulation processes.

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18.

The apparatus of claim 1 wherein the near infrared radiation is in the approximate range of 400 nm to 1100 nm wavelengths.

19.

25 The apparatus of claim 1 wherein the sensor is a fiber optic.

20.

The apparatus of claim 1 wherein the detector is a photodiode array.

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21.

A method of analyzing a substance comprising the steps of:
irradiating the substance with near infrared light;
35 with a sensor, sensing near infrared light which reflects off or passes through the substance while moving at least

one of the substance or the sensor relative to one
another;
isolating the sensed radiation into one or more narrow
portions of the spectrum;
5 analyzing one or more of the isolated narrow portions; and
determining the identity and amount of constituents in the
substance.

22.

The method of claim 21 wherein the near infrared light
10 is in the approximate range of 400 nm to 1700 nm in
wavelength.

23.

The method of claim 21 wherein the sensor is moving
relative to the substance.

15

24.

The method of claim 23 wherein the sensor is positioned
on one of the set comprising an automobile, a trailer, a
water craft, a barge, an agricultural implement, a rail car,
and an aircraft.

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25.

The method of claim 21 wherein the substance is a pre-
harvested agricultural product.

26.

The method of claim 21 wherein the substance is soil.

25

27.

The method of claim 21 wherein the substance is moving
relative to the sensor.

28.

The method of claim 27 wherein the substance is a moving
30 in a conduit

29.

The method of claim 21 further comprising utilizing the
constituents for agricultural product hybrid development.

30.

35

The method of claim 21 further comprising utilizing the
constituents for agricultural breeding programs.

31.

The method of claim 26 further comprising utilizing the constituents for soil analysis.

5 The method of claim 21 further comprising utilizing the constituents for non-destructive analysis of nutraceuticals.

33.

10 A method of analyzing constituents of a substance in real time in a non-laboratory setting subject to diverse and changing environmental conditions comprising the steps of: irradiating the substance with near infrared light; with a sensor, sensing near infrared light which reflects off or passes through the substance while moving at least one of the substance or the sensor relative to one
15 another;
isolating the sensed radiation into one or more narrow portions of the spectrum;
in real time analyzing one or more of the isolated narrow portions; and
20 determining the identity and amount of one or more constituents in the substance.

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The method of claim 33 further comprising carrying a source for said near infrared light, the sensor and devices
25 to isolate and analyze the sensed radiation on a mobile carrier, which can be moved past the substance.

35.

30 The method of claim 33 wherein the substance is selected from the set comprising pre-harvested agricultural product, post-harvested agricultural product and soil.

36.

The method of claim 35 wherein the pre-harvested agricultural product comprises nutraceuticals.

37.

35 The method of claim 35 wherein the post-harvested agricultural product comprises nutraceuticals.

38.

The method of claim 33 wherein narrow portions of the spectrum are isolated without moving optical components.

39.

5 A system for measuring constituents of a substance in
real time in a non-laboratory setting subject to diverse and
changing environmental conditions comprising:
a light source capable of producing near infrared radiation
in a controllable direction to a substance location;
10 a sensor oriented towards the substance location and capable
of sensing ^{near}infrared radiation reflected from or passing
through the substance location;
a monochromator having no moving optical components and
capable of isolating narrow portions of the infrared
15 spectrum and a detector positioned to detect and
quantify one or more isolated narrow portions of the
infrared spectrum created by the monochromator;
a communication member between the sensor and the
monochromator to transfer the sensed infrared radiation
20 to the monochromator; and
a processor operatively connected to the monochromator
capable of identifying and determining the amount of
constituents in the product based on the detected and
quantified one or more isolated narrow portions of the
25 infrared spectrum;
the light source, sensor, monochromator, communication member
and processor being moveable relative to the substance
location or vice versa.

add c 6